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Our readers are aware doubtless of the amount of damage to public works by the late severe freshet, which has spread destruction over a greater extent of country than any like disaster for many years. Bridges without number have been destroyed, and several canals have suffered severely, but none so much as the Lehigh canal. The embankment at the dam of the Croton aqueduct has been swept away to a considerable extent, and the disaster in that vicinity, besides the immense destruction of property, was accompanied by loss of life. It is not our intention to enter into a detail of these misfortunes—for the present we desire simply to draw attention to one particular topic connected with them, from which instruction may be drawn.

In all freshets, and particularly in that which has so lately taken place, it will be found that while the severest loss has been in bridges, these structures themselves have very greatly increased the damage to other property besides destroying other bridges. The reason of this is obvious enough. In a narrow gorge an ordinary bridge, with its piers, soon forms with the ice and drift wood, a dam which restrains the flood only until it has reached a sufficient height to sweep every obstacle before it, and then rushing on with the accumulated fragments of mills, houses, bridges, etc., to the next obstruction. The same process is repeated until nothing can resist its fury.

We need hardly say, that in all such situations we would recommend the erection of *wire suspension bridges*—in most cases the cheapest that can be built—offering no obstruction to the flood, and frequently affording superior accommodation by crossing at a height impracticable in any other form of bridge. The action of

ice, at all times unfavorable to ordinary bridges, is almost certain destruction whenever its removal is accompanied by freshets. We had occasion last year to call the attention of our readers to the damage sustained by this cause, and to recommend the same remedy we now propose.

We can only account for the slow introduction of the more improved form of suspension bridge, by the want of popular information. The members of the profession are well acquainted with the advantages of this form of construction, having the experience of the European engineers before their eyes. The suspension bridge, although attempted at an early date in this country, has found but few admirers in its present highly perfected state, and it is now the duty of engineers to urge the attention of those interested, to the best models.

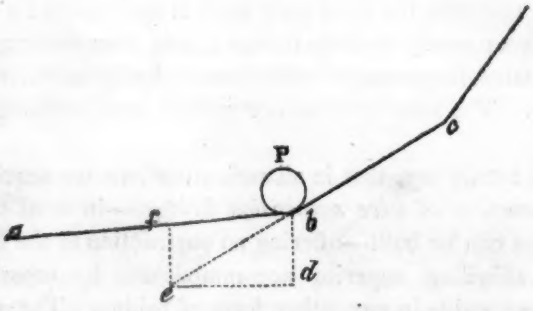
We could not do justice to this subject without advising our readers to turn to the papers of Mr. Ellet, who has done more than any one else to spread information likely to be useful throughout the country. We hope he will not lose the present opportunity to press the matter in the public prints.

For the American Railroad Journal and Mechanics' Magazine.

THE MOTION OF BODIES ON CURVED INCLINED PLANES, AND THE CONTROVERSY, PENDING ON THE "THEORY OF THE CRANK," SETTLED.

The *Theory of the Crank*, as offered by "Fulton," and his objections to my demonstration, which has been the cause of a series of arguments in the Journal, has induced me to investigate the motion of bodies on curved inclined planes more attentively than I have done before, in order to arrive if possible, at a conclusion, which when applied to the *crank motion*, would, from the close analogy of the two cases, bring the matter in dispute to a satisfactory issue.

The following demonstration to that effect has forced itself upon me as correct.



Suppose *a b c*, represent a series of inclines, meeting at *b*, *c*, and

P, a rolling body, arrived at *C*. The direction of the body *P* will then be changed from *c b* to *b a*.

If the direction of the plane *c b* was not changed, but continued by *b e*, the moving force of the body *P*, and which may also be designated by *P*, would continue in an accelerated proportion according to the laws of gravitation.

Let the force, with which the body would continue upon the plane *b a*, be represented by the line *b e*, itself, then we can, by forming the parallelogram of forces *b*, *d*, *e*, *f*, resolve this force into the two forces *b d*, vertical to the plane *b d*, and *b f*, in the direction of the plane *b a*.

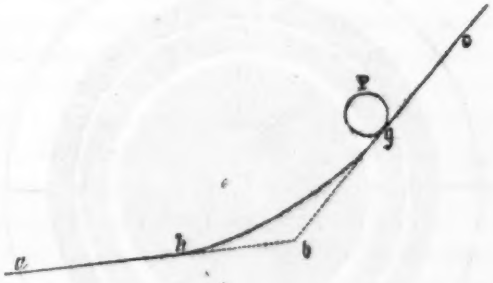
It is evident, that the force *b d*, will have no influence upon the motion of the body *P*, in the direction of the plane *b a*, and that all the force, left for the motion of the body in that direction, is represented by the line *b f*.

b f, being less than *b e*, we see that a loss of power is occurred by the transition of *P*, from the plane *c b*, to the plane *b a*, and that this loss is representented by the vertical *b d*.

Let us denote the angle *a b e*, by α,

The force *b e*, by *P*,

The force *b f*, with which the body will move over *b a*, be marked *F*, then will be $F = P.\cos \alpha$



Now let us suppose, the two straight planes *b c*, and *b a*, instead of meeting at an angle at *b*, be connected by a curved incline, *h g*, to which the two planes *b c*, and *b a*, form tangents. Then the angle *h g b*, which here takes the place of α, is reduced to nought; and as

$$F = P.\cos \alpha$$

and the cosine of nought is equal to the radius, which is here assumed to be 1, we get $F = P.$

Therefore the force *F*, with which the body begins to move over the curve *g h*, is not diminished and equal to the power it had attained when arrived at *g*.

And from this, I am obliged to acknowledge as a general principle: "That there is no loss of power attended with the motion on curved inclines."

And from the close analogy, which exists between this case and the motion of bodies in curved lines generally. I also admit as a general law: "That no loss of power is sustained by the change from a straight into a rotary motion, or any other curved motion, leaving friction and all other considerations out of view."

The same principle applied to the *crank* I do likewise admit, "that there can be no loss of power connected with the use of the crank, arising from its circular motion."

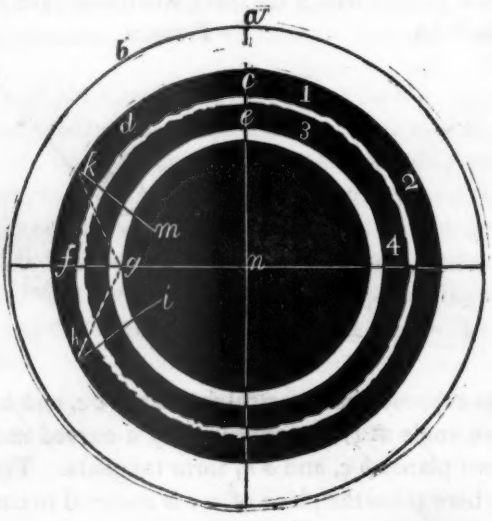
Although I can, as yet, not altogether reconcile my views to "Fulton's" demonstration, and to his last remarks, in reply to me, I feel still bound to say, that I consider myself indebted to the calm and methodical reasoning of that *gentleman*, for the conclusion I have now arrived at.

JOHN A. ROEBLING, Civil Engineer.

Harrisburg, December 1840.

For the American Rrailroad Journal and Mechanics' Magazine.

MAGNETIC MERIDIAN.



A book has been recently published which is entitled "The Architecture of the Heavens," and in which the author, who appears to have been competent for the task, has collected many of the telescopic observations of the Herschels and of other eminent astronomers upon the regions above us; and, among other things, we are told in the volume in question, that the telescope brings to view

many large and somewhat globate masses of matter in the space around us which appear to be in a very rare state; and such is supposed by men like the great Laplace, to have been the original condition of all the bodies of the solar system. The matter of which the earth consists, for instance, is supposed by the most judicious physicians of the age, as appears from their publications, to have been once extended even beyond the orbit of the moon; and to have been gradually condensed to its present dimensions. During this condensation latent caloric was evolved from the matter of which we are speaking, and thus rendered free; and in this latter state, it is supposed to exist now, to a great amount in the interior of the earth; so as to have long since transformed, and to keep the whole in a state of fusion; and, it may be remarked in passing, that, according to this theory, much of the external crust of the earth which is called *secondary*, never became hot enough to be wholly melted, and is consequently, in reality of a *primary* character.

Another remark we have to make by way of introducing our principal subject is, that the circumstance that the rotation of the earth changes the position of the masses of iron near the poles or extremities of its axes but little, while it changes that of those in the vicinity of its equator very much, is a sufficient reason why the magnetic needle should lie as we find it to do, and not in an eastwardly and westwardly direction.

Suppose the matter of the earth to have once extended to the circle at *a* in the accompanying diagram; and that the particle at *a* moved to *b* in the time of one hour. Let it settle, in consequence of condensation to *c*, and it would tend to move the same distance, and even a little further, though that circumstance needs not to be taken into consideration now, to *d* in the same time. Or, in other words, its tendency to preserve its *real* velocity would increase its *angular* one, and that increased angular motion it would communicate in part to what we shall suppose to be melted matter at *e*; but, from that matter it would soon break, and leave the same behind it in its motion upon the common axis.

Again, the matter at *e* would cool to solidity and contract enough to enable it to move faster than would the nucle *n*, within it, but not enough we may properly suppose, to cause it to move even so fast as does the coat or envelope *c*, which surrounds it. And something like this we do actually observe in the concentric rings of the planet Saturn; and, if a segment were cut from each polar region of the earth by a plane passing at right angles to its axis, the remainder would probably exhibit to a distant spectator the same appearance which Saturn now does.

We have further to remark before coming to the point at which we are aiming that from the 19th volume of the Franklin Journal of Science, page 231, it appears that iron at a red heat has no effect upon the magnetic needle; and, consequently, in the case before us we must pay no attention to the melted mass which constitutes the nucle *n* though we may observe in passing that it will be subject to the same tides as are the fluids upon the earth's surface; and those tides will probably rub occasionally against the rough portions upon the interior surface of the coat *e*, which surrounds them; and furthermore the rough portion upon the exterior surface of the same coat *e*, may come occasionally in contact with those of the interior surface of the coat *c*, which lies above it; and thus electricity *may* be developed; and *possibly*, this may be the cause of the polar auroras, as well as of the chemical or electric action, which endogeologists are inclined to think gives rise to the metalic veins that are found in the earth.

Furthermore we have to remark that the metals in the interior of the earth are *probably* so mixed together, that the whole mass is equally fused, though when they cool down to a certain temperature a chemical or electric action takes place *perhaps*, and separates them into crystals or veins; and thus, in my humble opinion, we can imagine something correctly respecting the formation of granite and other primitive rocks.

The figures 1, 2, 3, 4, etc., in the diagram already referred to, indicate masses of iron in the northern portion, suppose for the moment of the coats *c* and *e;* and the resultant of these attractions gives to the magnetic needle a certain direction, we suppose for every different point upon the earth; but soon their relative position is changed, as 1 and 2, in the coat *c*, move faster than do 3 and 4 in the coat *e;* and this will give to the magnetic meridian of any place, as we actually find to be true, sometimes a westwardly, and then again an eastwardly declination. That is, when 3 and 4 are above the horizon of an observer at the equator, their motion will be *relatively* westwardly; and consequently, the northern portion of his magnetic meridian, if it is not counteracted by a southern influence, will decline to the west; but when they are below his horizon, which may be some hundreds of years afterward, their *relative* motion will be eastwardly; and the same portion of his magnetic meridian not being counteracted as above mentioned, will decline to the *east.*

It is well settled by observations, the particulars of which are recorded in our scientific journals, that the resultant of attraction

above mentioned, is not the same geographical point for all, and perhaps not, unless accidentally, for any two places upon the earth. That is, suppose the figure before us to be a direct or orthographic perspective projection of the northern or southern hemisphere. *n* being the pole, the concentric circles, parallels of latitude, and the line *f g n*, a part of a meridian. If the needle at *f*, points to *g*, the same at *h* or *k*, would not point there, as indicated by the dotted lines, but perhaps in the direction *h i*, and *k m*.

According to this theory the variation of the magnetic meridian of any place upon the earth will be *periodic;* but it does not thence follow that it will be *uniform;* nor does it follow for a certainty perhaps, that we shall ever ascertain how much faster the coat *c*, moves than does the coat *e*, or the nucle *n*, upon the common axis. At any rate, it is easy to imagine many formidable difficulties that would be likely to present themselves to such an inquiry.

The polar auroras have an obvious influence, as appears from the testimony of many observers upon the magnetic needle; and beyond this we know quite as little about them as we do of the trains of comets, and that is well known to be little enough. Professor Twining gives us, in the 32d volume of the American Journal of Science, some reasons for supposing them to be much higher than is the atmosphere which surrounds the earth; but this needs confirmation. The fact is, they appear to be something like the rainbow, identical to no two individuals. Perhaps the phenomeny in question may prove to be electricity emenating in a certain manner from the earth, and evolving light pursuant to some law in the higher regions of the atmosphere above us. Brewster, the great optician, says, according to the 34th volume of the American Journal of Science, that the light in question does not appear to be *reflected* but *radiated*, or emitted to us.

Since penning the above I find in Hutton's Mathematical Dictionary that the opinion of Dr. Halley respecting the variation of the magnetic meridian are very similar to mine; and would have been doubtless identical with it, had he taken into consideration as I have done, the opinion now prevalent respecting the history and present state of the earth.

OLIVER SMITH.

THREE GREAT LINES OF RAILWAYS, EXTENDING FROM THE CITY OF NEW YORK, TO THE UPPER LAKES,

In the absence of a more full description of the three main lines of railways to the upper lakes, with a fourth branching off at Syracuse by Oswego, lake Ontario, and the Welland canal to lake Erie,

the following hasty sketch is given of the enviable portion of the city of New York, to maintain her commercial supremacy.

This is exhibited, and strongly illustruted in the profiles of the routes and distances from this city.

From New York, by Philadelphia to lake Erie, is	534	miles.
From the same by Piermont to Dunkirk,on lake Erie,	484	"
Ditto by the way of Albany, to Buffalo	470	"
Ditto Ditto to Oswego	315	"

Since we have perfected a continuous line of railway from Jersey city by Trenton to Philadelphia, over nearly level ground, it is ascertained, that with the advantage of a large passenger business, and *a goodedge railway*—merchandize may be transported so cheap, as to make New York the seaport of Philadelphia—certainly for the importation of valuable merchandize.

It will be perceived, that the position assumed by Mr N. Biddle, at the State convention at Williamsport in 1838, "*That Philadelphia is* 100 *miles nearer to tide waters, from the upper lakes, then the city of New York,*" is not correct, This statement, however, was made at the period when judge Wright's first survey stated the distance from lake Erie, to Tappan at 483 miles, and to the city hall 508 miles. The distance has since been reduced, 25 miles, also the grades, and inclined planes *dispensed with.* From the city hall to Dunkirk, as survey of E. F. Johnson, is 484 miles.

Since a continuous line of *railway* from Jersey City, by Brunswick and Trenton to Philadelphia has been completed, with the prospect of its being continued to the village of Erie, by Sunbury and the Clarion summit, it is safe to assume, that the best market for the products of Pennsylvania, will be found in the city of New York, and the best outlet to and from the ocean, for at least four months in the year, will be through the narrows, at New York. Not so with the line of railways extending from *Boston, by Albany to Buffalo.* The city of New York, without a continuous line of railways to Albany and Troy, *constructed within the limits* of our State and jurisdiction, and *under one charter*, will have less to boast of, than will the statesmen of Massachusetts in their western railroad. They will have a road less in distance from Boston to the upper lakes, than the boasted line of Pennsylvania.

Heretofore there has been a singular delusion that has engrossed the minds of a large proportion of the citizens of New York, in relation to the Erie, or *southern railroad.* It has been presented to the public, as being of the *first consequence* to the city of New York, *to secure* the entire western trade, to "*compete with Penn-*

sylvania," while the competition with Boston has been lost sight of entirely. It has only been brought to our consideration, since Boston enterprize has borrowed the Dutch bonds of Albany, and purchased their charter, to complete their *Western* railroad from West stockbridge, to the outlet of the Erie canal. A road, (as Mr. E. H. Derby of Boston, observed, from the steps of our Capitol,) "*that will bring Albany within ten hours of Boston, and will virtually make it a sea port on the Atlantic.*"

We contend that the subject of reaching the upper lakes by the most direct route, has not been properly considered by our citizens. We admit that the construction of the New York and Erie railroad is of the first importance *to people* a fertile tract of country, through which it runs, and to connect us with the coal and iron districts of Pennsylvania. These reasons, should be urged by its friends, for its construction. A glance, however, at the profile of this road, with its numerous summits, sharp grades, and its termination, 25 miles from this city, on the *west* side of the Hudson, will make it a mixed line, by railway and steamboats, and of course expensive. This will probably preclude its competing with the line from the village of Erie by Sunbury to Philadelphia, and from thence to New York. It certainly cannot compete with the more favored line from the centre of this city by Albany to Buffalo with a distance of only 470 miles, and easy grades, much less with the route by Syracuse and Oswego to lake Ontario. The distance on this line is only 168 miles, from the lakes to tide waters, or 315 from Oswego to the city hall. This line has advantages, that must defy all competition when its advantages are developed by the construction of 35 miles of railroad from Syracuse to Oswego.

This route must share largely with Buffalo in the western trade. For all practical purposes, "*the trade of the upper lakes is now let down into lake Ontario*" by the Welland canal.

It will be perceived, that by the Ontario route there will be a saving of about 150 miles in tolls and transportation, and a greater use of natural waters, after the goods are shipped. With this advantage, there cannot be a question but that the city of New York can successfully compete with Philadelphia for the western trade, and offer a more certain market for the sale of western produce.

Without the prompt construction of permanent railway from this city to Albany, equal to that constructing by the citizens of Massachusetts, from Boston to the outlet of the western trade, through the valley of the Mohawk by Albany, it is evident, that a large portion of our present trade will be diverted from us. We

have more to fear from eastern enterprize, since the advantageous introduction of railways, than is admitted by our citizens, who depend on river transportation, to compete with our neighbors.

J. E. B.

For the American Railroad Journal and Mechanics' Magazine.

In the structure of the Croton aqueduct there are some arches which are elliptic while the rest are circular ones; and the latter have about one-fourth more of weight upon their hances than the fomer have; and yet, according to the reasoning of some, they are *both* just right!!!

Did you ever hear, candid reader, of such ridiculous rigmarole before? The arch of equilibration is no arch of equilibration at all, while the elliptic and circular ones, though differing about one-quarter the one from the other, are *both*, it is contended, exactly correct! To be serious, would it not be advisable to put such reasoners into a straight jacket, and send them to the lunatic asylum?

Perhaps you will ask me what I expect to gain by such articles as this, and the one in the last number of this Journal, respecting the Croton aqueduct? Sir—I shall gain this:—I shall vindicate the scientific honor of my country, I shall defend the mathematicians of this vicinity from the imputation of being ignorant of this subject; and we have Adrain, Strong, Gill, Anderson, Ward, O'Shanessey, and others of no inconsiderable eminence, within 15 miles around us. I shall give the Aragos, the Youngs and the Ivories of Europe to understand that we know something, and perhaps as much as they do, of the properties of curved lines; and that the genius of American science did not die with our revered Bowditch. In short, I shall show to the world, that if the worst of all arches must be adopted in the aqueduct bridge which is now being erected over the Harlem river, the reason is not that we have not among us our full proportion of individuals who know how to construct the proper ones. This I am sure of gaining, and perhaps it will be all that I shall be able to accomplish in this case; and even this, insignificant as it may appear to some, will be in my estimation, "glory enough" for one little effort.

It must be borne in mind that the mathematicians of this vicinity will not interfere in this case unless they are properly called upon to do so. I requested the American Institute to give this call, and they promptly, and doubtless very justly, voted that it would not be proper for them, being as they are, not a scientific institution, to do so. The same request I have made to the Mechanics' Institute of this city, and expect the same answer from them. Supported

by a considerable number among the first characters here, I have petitioned the common council of this city to take the opinion of some of our eminent mathematicians upon the subject before us, and report thereon, in order that the public as well as their honorable body may be enabled to act understandingly in any further steps which may be thought proper in the premises; and several individuals of both boards, and of both political parties, have assured me that they shall be decidedly in favor of doing so.

Gentlemen of the common council of our city—you will bear in mind that I cannot appear before your body to give explanations, and must therefore give them in this way, if I give them at all. You must be aware that you are not presumed to be judges of this subject yourselves, and that, consequently, it is not *your* opinion which is asked respecting it. Give us the opinion of those who are known to be so, and then the public can do in this case as they please; and if they find occasion to apply to our State legislature for permission to have arches different from those which are intended to be erected in the structure in question they can do so. But you must be fully sensible, gentlemen, that no such application would be of any avail without your concurrence; and shall it be said, during all future ages, that our common council for 1840–1, refused so small a request, supported as it is known to be, by many of our most respectable citizens? Bear in mind that this opinion will cost the city nothing. I know what it will be, in case it is taken; and I wish it laid before the public *officially* and *formally* so that the authors of it may consider themselves responsible for it to posterity as well as to their cotemporaries. The work in question will be always more or less criticised by individuals from all countries; and the fact, whether the constructors did or did not understand the properties of an arch, will be obvious to the scientific observer; and the same pen which records that fact will be very likely to learn either from tradition or written documents, the success of this application. So that the common council of the city of New York for 1840–41 are in the way, at least, of having their names immortalized, either for refusing to give, or for actually giving to science a fair hearing. Yes, the remotest posterity, being probably enabled to single them out by means of this very circumstance, will look back upon them with either contempt or respect. And can an individual of that body hesitate for a moment in choosing which of these he will have his memory to meet?

A copy of this article will be sent to each of the gentlemen who have been here mentioned; and it is presumed that, acquiescing in the

demonstration under consideration, he will perceive no occasion to object to the liberty here taken with his name. Should any one, however, whether among them or not so, be of the opinion that the equilibrated arch is not what it purports to be, it is hoped he will give his objections in this Journal, and they shall be properly answered. Neither the writer in the New Edinburgh Encyclopedia who was referred to in my other article of which I have herein spoken, nor Mr. Robison in the Encyclopedia Britanica, whose directions the engineers appear to be following in the case before us, gives any reasons for his wholesale remark in effect, that modern science claims more in this case than is due to her; but besides their gross blunders in quoting the analysis which obtains the intrade when the extrade is given, they make assertions, both of them, in regard to equilibrating a given arch by the synthetic method, which are very far, as I can point out to any competent judge of the subject, from being correct.

But what do you mean, it may be still asked, by equilibrating an arch? I mean, placing the vousoirs so that the line of thrust, commencing at the crown or key stone, will pass from one to another, and thus fall upon the spring or top of the pier. Such is not the case in regard to any arch in the structure of the Croton aqueduct; but in all of them, the line in question runs above the vousoirs and top of the pier into the loose masonry or, perhaps, loose earth, where no provision is made for it. and consequently, it is merely by *accident* that those arches stand. The vousoirs, so far as the thrust is concerned, are entirely useless, and might be removed, provided they were placed upon the top, so as to give the same pressure downward which they now do. Whatever they effect, is due, not to their form and position, as the case should be, but *solely* to the *stiffness* of the material of which they consist. Do you ask, who says so? My answer is, I will convict any one who does not say so, the individual himself being judge, of a total ignorance of the subject. Give us the investigation here requested. It shall cost the city nothing; and the arches that will be thus agreed upon for the Harlem bridge, will contain less masonry and consequently be less expensive than would the ones which are now for that purpose intended, and be as much stronger than they would be as a perfect arch is stronger than is a mere pile of stones and of earth that are thrown indiscriminately together.

Now look for a moment at the progress of science. Descartes first applied equations to curves. Dr. Hook suggested the catenary as an equilibrated arch of the simplest character. Newton, and a

few years after him, and independently of him, Leibniz discovered the calculus. Simpson, and perhaps some others before him, applied that mode of analysis to the equilibration of an arch; and the universality of that application was completed about fifty years since by Hutton, and it remains for us, not only to apply the principles thus developed to given cases, but to defend them, and show the objector that he does not understand the subject.

OLIVER SMITH.

FARE ON RAILROADS.

(Continued from page 64.)

Is my assumption correct, that the present rates are too high both for the interests of the stockholders and the public? I will endeavor to show that it is capable of demonstration. The eastern railroad is a case in point. This road has been in operation nearly a year. Its cost has much exceeded the average cost of roads, and as it runs along the seaboard, its principal dependence must be on passengers; yet the directors have boldly tried the experiment of a low rate of fare, and have tried it with complete success. The ratio of increase has been vastly greater than any route; and singular as it may appear, the passengers who weekly enter the city by this eastern road, exceed in number those who enter by all the other railroads. And this road, with little or no income from freight, with an expensive ferry, is already earning more than ten per cent. per annum.

What is the cause of this immense travel, this wonderful increase? It must be ascribed to the reduced rate of charge; and so well persuaded of this fact are the intelligent directors of the road, that they have a further reduction in serious contemplation, and the public need not be surprised if they soon lower the charge to Salem to 25 cents. What will those old gentlemen say to this who predicted at the opening of the road the rate would rise to a dollar? They must feel they were a little behind the age. There is one prevalent mistake upon these subjects. Men reason from experience in stage coaches, not in railroads; the latter are novelties in which few have had experience. Now it is susceptible of proof that no stage coach carrying passengers and their trunks any considerable distannce, can live at a charge less than three cents per mile; but a railroad whose trains shall average two hundred passengers, may pay its expenses at a charge of half a cent per mile, it having been well ascertained by the Chevalier de Gerstner, in his recent tour through the United States, that the cost of sending a train over a railroad is the same throughout Belgium and the United States, viz., $1 per mile, and a single train can easily transport two hundred passengers. It may be assumed, therefore, that a railroad which can command 200 passengers to a train, may transport them 100 miles at an expense of 50 cents each, and in such cases may carry them without loss at one-sixth part of the expense of each to to a stage coach. This difference allows great leeway for a reduction from the stage coach rate, and it is apparent that a road may prove profitable in a populous country at the low rate of a cent per mile; and as there is scarcely any limit to the capacity of a railway for transporting passengers, it follows of course that a population sufficient in numbers and wealth to supply travellers, is all that is requisite to insure the success of a railway at a very low rate of fare. I would not advocate, in the present state of our population, the adoption of this extreme low rate, but I would contend that three

cents per mile should be the highest charge upon any of the railways of Massachusetts, and that this rate should be occasionally reduced when we are to compete with our sister States on nearly equal terms for the trade of the interior. But it may be said that the Providence road, with high charges, has thus far made the highest dividends. This is true, but it does not affect the truth of my position, for its success is obviously ascribable to other causes. It has derived an immense patronage from the steamboat competion on the Sound. It is at present the only feasible route between New York and Boston. Its supply of passengers to and from New York is water borne through the Sound at a charge varying from 3-4ths of a cent to 2 1-4 cents per mile, and accomplishing the principal part of the distance at a low rate, they reluctantly pay the extra tax of the Providence road; but this high rate invites competition, and has conduced wonderfully to the building of the Norwich road; and the opening of the latter must soon reduce the rate, or leave the Providence road a beggarly account of empty cars. The Providence road will then, if it reduces, hold a divided empire over the New York travel, securing of course a considerable proportion of it, as it is most direct; but it will find in this very reduction a new scource of income in the general increase of travel. Let the rate between Boston and Providence be reduced, as it should be, to $1,25 for passage, and the charge for freight reduced to $2 1-2 per ton, about the rate now charged by the Lowell road, and the reduction will produce a wonderful accession of patronage; the local travel along the route and between the terminii will wonderfully increase. When the Providence trader can come to Boston and buy his goods at less expense of time and money at New York, he will come often, will buy large quantities of merchandize here, and send it home over the road, which he is deterred from doing now by the high rate of charges. At present he can send his goods from New York to Providence, 180 miles, for less than one half the price charged for 43 miles only on the Providence road; and who sees a Providence customer in Boston? This road, for the purposes of commerce, has thus far been of little or no service to Boston, and one may almost imagine he can see a New York influence in its management; for the New Yorker, in his private speculations, keeps constantly in view the prosperity of the city he inhabits.

What bearing has the history of the Worcester road upon this subject? The Directors originally put the fare at $1 50, and subsequently, at a period of great depression, raised the rate to $2. A little experience has shown that they gained nothing by the advance. Many were deterred from travelling; stages began to interfere with the road, and not a few of the early friends and patrons of the road became disaffected; and the result has been that the directors have recently found it the wisest policy to recede to the original rate; and even this will be found too high when the Western road shall connect it with those great channels of travel, the valley of the Connecticut and the Mohawk. Thus far this road has come in contact with a sparse population only; it will soon reach too of the great arteries of travel, and it will depend in a great measure upon the directors of the Worcester and Western road, whether this travel shall be directed to Boston.

The rates of freight differ upon our several roads; upon the Lowell and Worcester roads they are lowest, viz: on the Lowell a little less and on the Worcester a little over 8 cents per ton a mile; on the Providence as high as twelve cents per ton a mile, or fifty per cent. more than the Lowell, and Worcester, beside an extra charge on many specific articles; this operates as a heavy tax on the transit of merchandize, and materially checks the transportation upon the road. But it may be urged railroads

derive their principal profit from passengers, they can make little or nothing upon freight. To a certain extent this may be true. If the charges are so high that little is forwarded, and a train capable of carrying 100 tons, is daily sent over the road with 20 or 30 only, little profit can be made, as the expense of the train is not materially diminished by the reduction of the quantity, except with respect to the charges of lading, unlading, and weighing.

On the Lowell road full trains are sent evry day over the road and, it has almost entirely superseded the canal. It may be inferred, from the recent reports to the Legislature, that the entire expense of transportin a ton over this road does not exceed 82 cents, and as the expense of weighing, lading and unlading and delivery, may be estimated at 37½ cents per ton, the actual cost of transportation cannot much exceed 45 cents per ton, and possbly is less. Thus conducted, the road derives a net profit of about $50,000 a year from its freight, a large part of its income, materially accommodating the public and greatly enlarging its own revenue. Supposing the rate of expense to be the same on the Providence road, the actual cost of sending a full train of merchandize over the road, would be about $1 06 per ton, and a charge of $2 40 per ton, which is the steamboat charge from New York to Providence, nearly 200 miles, would afford a liberal return. It is estimated now, that not one-fifth of the merchandize passing between Boston and New York, goes over this road; a large proportion of the traffic between Canton and the various towns on the route and the seaboard, is conducted by wagons, and the present charges must operate nearly as an interdict on the trade between Boston, Providence, and Taunton. The latter towns receive their supplies by water much cheaper from New York than Boston, and when the New Bedford road is opened, her position will be similar. Let the rate be reduced at least one half, and an active and bustling commerce must spring up between these flourishing towns, a great accession of freight be received by the road, and this collateral benefit gained, that every ton of freight will secure additional passengers. Thus far the Worcester road has had an apology for charging as above because no sufficient return freights offer at Worcester. While the ascending trains average 48 tons, the descending trains bring but 12 back, the cost of transportation is of course enhanced. When the road reaches Springfield, a low rate for descending produce and goods will doubtless command full trains, and a proportionate reduction may be made. An average charge of $4 or $5 per ton from Boston to Springfield, will be proportionate to the sum indicated for the Providence road, and it is to be hoped that this or a lower rate will be adopted.

The great Western road of Massachusetts rapidly approaches completion. Within six weeks it will be opened to Springfield, and the fertile and extensive valley of the Connecticut will at length find an eastren outlet. The ensuing year will witness the completion of this road to the Hudson, its connexion with the railways and canals of New York, and it may safely be predicted, that within the year 1841, the traveller and the mail will pass from Boston to Detroit within sixty hours. The importance of this road, is, and has been appreciated by the public, and deep solicitude has been felt for its success. All doubts as to its completion seem now to be dispelled; the persevering spirit of its originators, the liberal aid of the State and the judicious management by the directors of their scrip in London, insure its successfull progress.

Neither can any doubt remain as to the wonderful despatch it will give both to travel and trade. The question which now arises, is not whether it shall be finished, but how it shall be made most available to the shareholder

and the public. The management of the road, when finished, is full as important as its construction. In vain will the millions invested in this costly enterprise have been expended, if the charges shall be such as to prevent or materially restrict its use.

There is a community of interest between the entire State and the shareholders, that this road should conciliate to Boston the trade of the valley of the Connecticut, and a liberal share of the commerce of the North and West.

The success of this noble avenue must very much depend upon successful rivalry of Boston with New York, for the trade of the vast and fertile regions bordering on the Connecticut, the Mohawk and the lakes. It is easy to demonstrate, that this traffic cannot be conciliated unless a low scale of chagres must be adopted; and the profit of the road must spring from a moderate per centage upon a large amount of business.

With such a scale, only, can Boston compete successfully with New York. This great avenue to the west passes within twenty-eight miles of Hartford, the present head of navigation, and at Springfield strikes a point easily accessible from New York. The distance from Springfield to New York is but 125 miles, and the fare by the river steamboats to New York, is but $3, viz $1 to Hartford, and $2 from Hartford to New York.

Will it answer, then to put the fare between Boston aud Springfield above $3? If the country trader, descending the valley of the Connecticut, and arriving at Springfield, shall find that he can reach New York at a less rate than Boston, and can bring his merchandize from the former at a less freight than from the latter, towards which will he turn his face? It requires no astrologer to answer this question. But let the fares be the same, and let the charge of freight be even a trifle more from Boston by the railroad, the latter will have this advantage; it is 30 miles nearer Springfield, the journey may be accomplished in six hours only, and merchandize received the same day it is purchased. In distance, as well in winter, facilities, Boston will have the superiority, and this must be maintained by a cautious adjustment of the tolls. Still more important will this become, when the Western road shall strike Hudson River, and tap that immense stream of traffic and travel which now brings so rich a tribute into our sister city, New York. When the entire road shall be finished, ten hours will suffice to carry the traveller from Boston to the Hudson, the same period required by the fleetest steamboat for its passage down the Hudson. Through the entire year, then, the road, with respect to speed, will compare probably with the Hudson, and will not, like the Hudson, be sealed up by winter. But the usual cost of a passage on the Hudson is but $3, from Albany to New York; and 15 or 20,000 passengers who are weekly born between Hudson, Albany and New York, in fifteen spacious steamers and seven barges, which daily ply between these points, besides the crowds who sail in the fleets of sloops that whiten the river, pay no more.

This travel is constantly increasing; every link completed in the western chain of roads gives a contribution to it, and every village planted in the west adds its tribute. How is a fair porportion of this travel to be drawn over the western road? It can be drawn by a low rate of tolls only.

Some gentlemen of fortune, who have travelled, but have not studied this subject, will reply that a small difference in charges will not affect the travel; that if they wished to visit Boston, they should not be controlled by one or two dollars excess of charge. A man of fortune might not regard it but the majority of our travellers are not men of fortune; they understand the uses and value of money, and attach a value to the fractions of a dol-

lar; they forget not the maxim of the sage and philosophic Franklin, that a "penny saved is a penny gained;" and where different markets offer equal attractions, they are determined by the difference of cost.

The suggestion I am about to make is a startling one, but, after due reflection, I am satisfied it is correct. I would propose that a concerted arrangement be made by the three companies who form the chain of roads from Boston to Albany, to put the fare for the entire route at $3 as soon as the roads are finished. The roads will compete, both in speed and in price, with the Hudson; and I contend this rate will give to the entire route the greatest income. The cost of sending a train over a railway is, according to the Chevalier de Gerstner, both in Belgium and America, $1 per mile, and such train may with ease carry 250 passegers, weighing, and with their baggage, but 20 tons. The whole cost of sending this train from Boston to Albany, 200 miles, will be but $200; and if the trains should be so arranged (as they may be) to average 200 passengers, the entire expense will be but one dollar per passage, leaving a clear profit of $2 per head at a charge of three dollars. At this rate, 6000 passengers per week, the number which travels over our Eastern road, would give a net income of $624,000 per year, independent of freight, or 9 1-2 per cent, per annum on the entire cost of the three roads.

The Worcester having been estimated to cost	$1,700,000
The Western,	4,200,000
The Albany,	700,000
	$6,600,000

And at this rate, with corresponding rates of freight, it is safe to predict the number of passengers would exceed 6000 per week, or 500 each way per diem. If this computation be accurate, the road could well afford to transport merchandize at a moderate advance on the estimated expense of sending it on full trains, and a double track would soon become necessary to prevent an excess of profit over the rates indicated by the charters.

This result is brilliant indeed, but its very brilliancy may alarm the reader, can such moderate, such inconsiderable charges produce such immense results. To avert the suspicion of being a theorist or a visionary, I will endeavor to anticipate and to answer the objections which may be made. And first would there be travel enough to furnish 9000 passengers per week? I answer, the estimate is too low. What route in New England compares with the Hudson in amount of travel and trade. A careful computation rates the present travel on that stream at 15,000 per week, and in the natural course of things, it must increase next year. Is it not safe to presume that a route to Boston equally cheap and expeditious, will command one fourth that amount of travel? Why not? Boston is the seat of the domestic manufactures; may be bought here five per cent, cheaper than in New York; it is the centre of the fisheries, and two hundred miles nearer England, with which it will soon be united by a semi-monthly line of steamers. It is the best mart for Western produce. If the travel between the Hudson and Boston should be but 4000 per week, surely 2000 per week is a low estimate for the local travel, when the fare falls to less than two cents per mile, half the present rate on the Worcester road. Is the eastern route to be compared with this? Can the little towns of Lynn, Salem Danvers, Newburyport and Portsmouth, furnish more than three times the travel which will be supplied by the valley of the Connecticut, and the flourishing counties which line the road. Instead of 6000, the presumption is that the number will be 8000 or 9000 per week. Again can a train carry 200 passengers over the high grades of the road? The weight of such passen-

gers and baggage would not exceed 16 tons, and one of the improved engines just finished for the Western road, as an experiment; and if it should be retarded at all inscending the high grades, which are but of moderate length, its superior power would make up the loss of time on the level and descending portions of the route.

Have I not taken repairs and contingent expenses into account? In the estimate of a dollar per mile by the Chevalier de Gerstner, as the cost of a train, I understand the wear and tear of the engine and cars, and other current expenses, to be included; but if they are not, the profits of freight must be more than sufficient to cover them and the repairs of the road, leaving the net income from passengers a clear revenue.

The act of the Legislature granting the last loan to the Western road, virtually restricts the income to seven per cent, and the proprietors can gain nothing if the income should exceed six, inasmuch as the loan of the State is at 5 per cent., and the income of the road at 6 per cent., would pay the interest on the loan to the State, and 7 per cent, to the proprietors, partly by the creation of sinking fund. As respects the Western road, therefore, my calculations of profit may be reduced one third, and still the highest rate of revenue permitted by law, be realized by the stockholders. I do not hesitate, therefore, to propose, that on the opening of the Western road to Springfield, the fare from Worcester to Springfield be put at $1 50 or less, and the charge for freight at $2 00, and that efforts be made to bring the Worcester road into a corresponding arrangement.

The directors of the Worcester road are beginning to appreciate the benefits of low fares: their receipts during July have averaged about $5000 per week, at the reduced rates, being $1000 per week more than their average receipts during the past year. Although a portion of this may be ascribed to the summer travel, it warrants me in saying they have increased their revenue by the reduction of their charges; and my knowledge of the intelligence and liberality of this Board, assures me that they will cheerfully make an equitable arrangement as to tolls with the directors of the Western road. A further reduction of fare and freight, attendant on the opening of the Norwich and Western roads, would unquestionably bring a great accession of travel to the Worcester line, and swell its 1000 passengers per week at $2, to thousands at reduced fares. But if there were a doubt as to the policy of establishing such rates on the Western road, the wishes of the shareholders should be consulted, and those wishes are decidedly in favor of the experiment. Who are the proprietors of the road? They are the enterprising merchants, manufacturers, and artisans of Massachusetts; they took their shares not with a view to profit, but the advancement of commerce, and the development of the resources of the State; their interests are identified with the interests of the public, and whatever promotes the one conduces the other.

The interests of the public point to reduced rate of fares; I trust they will be consulted. D.

RAILROADS IN THE UNITED STATES. *By L. Klein*, Civil Engineer.

(Continued from page 368.)

RAILROADS IN NEW JERSEY, DELAWARE, AND MARYLAND.

The railroads in New Jersey were constructed by private individuals without any assistance on the part of the State; the most prominent of them is the Camden and Amboy railroad, which is the longest and has been constructed at a great expense. Nearly parallel with the same, and at a small distance only, runs another railroad, and both serve to connec

RAILROADS COMPLETED OR IN PROGRESS IN NEW JERSEY, DELAWARE, AND MARYLAND.

No.	Name of railroad.	From and to where.	Opened.		No. of Miles.			Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion.	Total cost of road.	Cost per mile.
			Year.	Miles.	Besides graded.	Not yet const'd.	Total length of road.						
1	New Jersey,	Jersey City to N. Brunswick.	1836	34			34	T rail 37 lbs.	9 locomot.	1,800,000	50,000	1,850,000	54,412
2	Paterson and Hudson,	New Jersey R. R. to Paterson	1834	14			14	plate $2\frac{1}{2}\times\frac{5}{8}$	4 locomot.				
3	Morris and Essex,	Newark to Morristown.,	1837	23			23	do. $2\frac{1}{4}\times\frac{5}{8}$	3 locomot.	327,000		327,000	14,200
4	Elizabethtown & Somerville.	Elizabethtown to Somerville.	1840	22		4	26	do. $2\frac{1}{2}\times\frac{5}{8}$	2 locomot.	300,000	50,000	350,000	13,462
5	Camden and Amboy,	Camden to Perth Amboy.	1835	61			61	T rail 38 lbs.					
6	Camden and Amboy Branch,	Bordentown to Trenton and New Brunswick.	1839	31			30	do. 48 lbs.	17 do.	2,700,000		2,700,000	29,348
7	Camden & Woodbury,	Camden to Woodbury.	1833	7			7		2 locomot.				
1	Newcastle & Frencht'n	Newcastle to Frenchtown.	1832	16			16	do. 40 lbs.	6 locomot.	400,000		400,000	25,000
1	Wilmington and Susq.	Wilmington to Havre deGrace	1837	34			34	do. 42 lbs.					
2	Baltimore and Port Deposit,	Havre de Grace to Baltimore.	1837	36			36	plate $2\frac{1}{2}\times1\frac{3}{4}$	10 do.	3,430,000		3,430,000	49,000
3	Baltimore and Ohio,	Balt. to Pittsburg & Wheeling	1834	85	25	325	435	T rail 52 lbs.	16 locomot.	4,000,000	9,000,000	13,000,000	30,000
4	Washington Branch,	B. & O. R. R. to Washington.	1835	$30\frac{1}{2}$			$30\frac{1}{2}$	do. 40 lbs.	4 locomot.	1,660,000		1,660,000	54,426
5	Baltimore and Susq.	Baltimore to York.	1838	58			58	do. 58 lbs.	12 locomot.				
6	Westminster Branch,	Baltimore and Susq. R. R. to Westminster.	1832	10		8	18	plate $2\frac{1}{4}\times\frac{1}{2}$	horses.	2,800,000	200,000	3,000,000	44,118
7	Baltimore & Annapolis.	Elkridge to Annapolis.	1840	$19\frac{3}{4}$			$19\frac{3}{4}$		2 locomot.				
8	Easetrn Shore,	Elkton to Somersetcove.			20	98	118			112,500	1,400,000	1,512,500	12,818
16				$480\frac{3}{4}$	45	435	$961\frac{1}{2}$		87 locomot.				

the two largest and most important cities of the United States—New York and Philadelphia. The railroads in this State have all a single track, the width of which is four feet ten inches. They are used for the transportation of both passengers and freight.

There is only one railroad in the State of Delaware, connecting the Delaware river with the Chesapeake bay. It has a double track, and was commenced as early as 1830. A part of the Philadelphia, Wilmington, and Baltimore railroad, also passes through this State.

In the State of Maryland a great deal has been accomplished in regard to railroads. In 1828 one of the most stupendous works in the Union—the Baltimore and Ohio railroad—was commenced; other railroads of great importance have been undertaken, and are for the greatest part finished. The State government has contributed much to promote the introduction of railroads, by granting loans or taking stock to a very large amount; and the city of Baltimore, aware of the incalculable advantages it must derive from being the centre of so many improvements, has liberally contributed its share to the same object. Nearly all the railroads in this State are of a very permaneut construction, with a heavy T rail, and the superstructure resting upon a solid foundation; but owing to the nature of the country through which they pass, very heavy grades had frequently to be adopted. The grading is done for a double track, but only a single track is laid down. The width is four feet eight and a half inches.

REMARKS.—Of the Paterson and Hudson, and Camden and Woodbury, railroads, the cost of construction has not been ascertained, as also of the Elkridge and Annapolis railroad.

The Wilmington and Susquehanna, and Baltimore and Port Deposit, railroads, form with the Philadelphia and Wilmington, railroad (see State of Pennsylvania) only *one* line, denominated the Philadelphia, Wilmington and Baltimore railroad; the total cost of the whole is, 3,930,000 dollars, and the number of locomotives, 14.

In the following summary statement of the railroads in the States of New Jersey, Delaware, and Maryland, the cost of the Paterson and Hudson, Camden and Woodbury, and Elkridge and Annapolis, railroads, has only been *estimated;* their length being inconsiderable compared with the total length of all the roads; the general results cannot be much influenced, should the estimate be a little too high or too low.

Name of State.	Number of railroads.	No. miles in operation.	Total length of railroads.	Number of locomotives.	Amount of capital expended.	Amount required for completion.	Total cost of railroads.	Average cost per mile
New Jersey.	7	192	196	37	5,547,000	100,000	5,647,000	28,826
Delaware.	1	16	16	6	400,000		400,000	25,000
Maryland.	8	273¼	749¼	44	12,400,000	10,600,000	23,000,000	30,700
	16	481¼	961¼	87	18,347,000	10,700,000	29,047,000	30,218

According to the above statement, there are now sixteen railroads in these three Atlantic States, with an aggregate length of 961¼ miles, of which 481¼ miles are already in operation, or nearly one half of the whole length. The number of locomotives employed upon 471¼ miles of railroads is eighty-seven, being at the rate of one engine for every 5.4 miles of road.

The sum of 18,347,000 dollars has already been expended, and 10,700,000 dollars more will be required to put in operation the still unfinished parts of several lines; of the 961¼ miles of railroads the average cost per mile will then be 30,000 dollars.

RAILROADS COMPLETED AND IN PROGRESS IN THE EASTERN STATES.

No.	Name of Railroad.	From and to where.	Opened.		No. of miles.		Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion	Total cost of road.	Cost per mile.
			Year.	Miles.	Besides graded.	Not yet constr'd.							
1	Bangor and Orono,	Bangor to Orono.	1836	10			10		2 locomot.				
2	Nashua and Lowell,	Nashua to Lowell.	1838	14¼			14¼	T rail 57 lbs.	3 locomot.	354,000		354,000	24,842
3	Boston and Lowell,	Boston to Lowell.	1835	26			26	do. 46 lbs.	7 locomot.	1,610,000	190,000	1,800,000	79,231
4	Charlestown Branch,	Bost.&Low'l rr. to Charlest'n	1839	1⅓			1⅓	do. 45 lbs.		91,028		91,028	68,271
5	Boston and Portland,	Bost. & Lowell rr. to Exeter.	1839	34¾			34¾	do. 45 lbs.	4 locomot.	610,000	90,000	700,000	20,144
6	Quincy,	Quincy Quar. to Neponsit riv.	1827	4			4	plate.	horses.				
7	Eastern (in Mass.)	Boston to State Line of N. H.	1839	25	12½		37½	T rail 45 lbs.	8 locomot.	1,306,196	193,804	1,500,000	40,000
8	Eastern (in N. H.)	Portsmouth to S. Line of Ms			10	5	15					600,000	40,000
9	Marblehead Branch,	Eastern rr. to Marblehead.	1839	3			3	do. 45 lbs.					
10	Boston and Worcester,	Boston to Worcester.	1835	44½			44½	do. 40 lbs.	10 locomot.				
11	Millbury Branch,	Boston and Worcerter rr. to Millbury.		3¼			3¼	do. 40 lbs	horses.	1,848,085		1,848,085	40,000
12	Western,	Worcester to W. Stockbridge.	1839	54½	33	29½	117	do. 55½ lbs.	8 locomot.	2,800,000	1,700,000	4,500,000	38,462
13	Boston and Providence,	Boston to Providence.	1835	42			42	do. 58 lbs.	11 locomot.	1,850,000		1,850,000	44,048
14	Dedham Branch,	Bost. & Prov. rr. to Dedham.		3			3	plate 2¼ × ⅝	horses.				
15	Taunton Branch,	Bost. & Prov. rr. to Taunton.	1836	11			11		2 locomot.	250,000		250,000	22,727
16	N. Bedford & Taunton	Taunton to New Bedford.			10	10	20	T rail 58 lbs.		151,039			
17	N. Y., Prov. & Boston,	Providence to Stonington.	1837	47½			47½	do. 58 lbs.	6 locomot.	2,500,000		2,500,000	52,632
18	Norwich & Worcester,	Norwich to Worcester.	1839	59			59	do. 56 lbs.	4 locomot.	1,360,000	140,000	1,500,000	25,424
19	Hartford & N. Haven,	New Haven to Hartford.	1838	18	10	10	38		2 locomot.			760,000	20,000
20	Housatonic,	Bridgeport to State Line.	1839	35		38	73		2 locomot.			1,095,000	15,000
20				436	75½	92½	604		69 locomot.				

RAILROADS IN THE EASTERN STATES.

The railroads in the New England States, principally those in the State of Massachusetts, are not only among the most solid and best constructed, but at the same time the most prosperous and profitable in the United States. They were all constructed by private companies; to several of which loans were granted on the part of the States. The oldest railroad not only in these, but in the whole United States, is the Quincy railroad, near Boston, completed in 1827. The longest will be the Western railroad, extending from Worcester to West Stockbridge, a distance of 117 miles; Nearly all the railroads in the eastern States have been graded for a double track, but with the exception of the Boston and Lowell railroad, only a single track has been laid down. The superstructure consists mostly of wooden cross ties upon mud sills, supporting a heavy iron rail of from forty to fifty lbs. per yard. The width of track is uniformly four feet eight and a half inches.

With the exception of a few short branches, locomotive steampower is used upon all the railroads for the transportation of passengers and goods. The income which is derived principally from the conveyance of passengers, is on most of these roads very considerable, and will average fifteen per cent. annually, on the cost of construction, although the latter is higher here than of the railroads in other States.

By an existing law, the railroad corporations in the State of Massachusetts have to make annual reports of the operations of their roads to the legislature. Much information may be derived from these reports, which would, however, be still more useful by containing more detailed data, principally in regard to the expenditures on the lines.

The foregoing statement is prepared from information attained mostly in the winter of 1839, and is therefore not complete; corrections were made from the reports, so as to show the progress of the works up to the end of 1839.

Remarks.—Of the Nashua and Lowell railroad nine miles are in Massachusetts, and five and a quarter in New Hampshire. Of the Boston and Portsmouth, twenty-five and three-fourths miles are in Massachusetts, and nine in New Hampshire. The Providence and Stonington railroad is nearly entirely in Rhode Island. Of the Norwich and Worcester railroad eighteen miles are in Massachusetts, the remainder in Connecticut.

In giving a summary statement of the railroads in each of the States of New England, the cost of construction of those which are located in two States has been divided in proportion to the length of the line in each of them, as there are no data for a more correct repartition.

Name of State.	No. of r. roads	No of miles in operation.	Total length of railroads.	Number of locomotives.	Amount of capital expended.	Amount required for completion.	Total cost of railroads.	Average cost per mile.
Maine,	1	10	10	2	200,000		200,000	20,000
N. Hampshire,	1	14¼	29¼	2	610,000	300,000	010,000	31,111
Massachusetts,	14	270¼	365¼	52	11,100,000	2,435,000	13,535,000	37,055
Rhode Island,	1	47½	47½	6	2,500,000		2,500,000	52,632
Connecticut,	3	94	152	7	1,905,000	1,000,000	29,05,000	19,079
	20	436	604	69	16,315,000	3,735,000	20,050,000	33,195

There are in the whole 20 railroads in the eastern States, with an aggregate length of 604 miles; of these, 436 miles were in operation at the

end of 1839, and the other 168 miles were in progress. Sixty-nine locomotive engines are employed upon 436 miles of roads, or at an average of one engine upon 6⅓ miles.

The total amount of capital already expended for railroads in New England is $16,315,000, of which $11,100,000 were expended in Massachusetts alone; with an additional sum of $3,735,000 all the railroads hitherto commenced will be completed and the total expenditure will amount to $20,050,000, equal to $33,195 per mile at an average.

In order to give a more general summary view of *all* the railroads in the different States of the Union, the following statement contains a recapitulation of the number and length of railroads in operation and progress in each of the States, of the number of locomotives employed thereon, the capital expended and that required to complete the works in progress, the total cost of the railroads when completed, and the average cost per mile.

Name of State.	Number of railroads.	Number of miles in operation.	Total length of railroads.	Number of locomotives.	Amount of capital already expended.	Amount required for completion.	Total cost of railroads.	Average cost per mile.
Maine,	1	10	10	2	200,000		200,000	20,000
N. Hamp.	1	14¼	29¼	2	610,000	300,000	910,000	31,111
Massachu.,	14	270¼	365¼	52	11,100,000	2,435,000	13,535,000	37,055
R. Island,	1	47½	47½	6	2,500,000		2,500,000	52,632
Connecticu	3	94	152	7	1,905,000	1,000,000	2,905,000	19,079
New York,	28	453¾	1317¾	45	11,311,800	10,503,000	21,814,800	16,570
Pensyl'nia,	38	576½	850¼	114	18,070,000	5,042,000	23 112,000	27,183
New Jersey,	7	192	196	37	5,547.000	100,000	5,647,000	28,826
Delaware,	1	16	16	6	400,000		400,000	25,000
Maryland,	8	273¼	749¼	44	12,400,000	10,600,000	23,000,000	30,700
Virginia,	10	341	369	42	5,201,000	250,000	5,451,000	14,772
N.Carolina,	3	247	247	11	3,163,000		3,163,000	12.806
S. Carolina,	2	136	202	27	3,200,000	800,000	4,000.000	19,802
Georgia,	4	211½	640½	17	5,458,000	4,320,000	9,778,000	15,266
Florida,	4	58½	217	5	1,420,000	2,400,000	3,820,000	17,604
Alabama,	7	51	432½	3	1,222,000	3,434,000	4,656,000	10,763
Louisiana,	10	62	248¾	20	2,862,000	1,834,000	4,696,000	18,880
Mississippi,	5	50	210½	8	3,490,000	2,240,000	5,730,000	27,221
Tennessee,	3	0	160½	—	1,100,000	855,000	1,955,000	12,180
Kentucky,	2	32	96	2	947,000	1,250,000	2,197,000	22,885
Ohio,	6	39	416	1	420,140	2,859,000	3,279,000	7,883
Indiana,	2	20	246	2	1,375,000	3,425,000	4,800,000	19,512
Michigan,	10	114	738½	8	1,896,000	5.653,000	7,549,000	10,222
Illinois,	11	23	1421	2	1,832,500	15,177,500	17,010,000	11,970
Total,	181	3332½	9378½	463	97,630,440	74,477,500	172,107,940	18,351

It appears, from the above table, that at the end of 1839 *the number* of railroads completed and in progress in twenty-four States of the Union, in which this kind of improvement has already been introduced, amounted to 181, of which 3332½ miles were opened and in use; 1707⅓ miles were besides graded and ready for the superstructure, and the total length of all the lines undertaken was not less than 9378½ miles.

The number of locomotive engines employed upon all the railroads in the United States, was at that time 463, (about one locomotive for every seven miles of road.)

As accurately as could be ascertained, the total amount expended on all the works, up to the end of 1839, was $97,630,440, the amount still required to complete the works that were commenced, was $74,477,500, and the total expenditure for railroads, when all the works in progress will be completed, will be $172,107,940. If this latter sum be divided by 9378½ (the length in miles of all the 181 railroads) we obtain $18,351 as the average cost per mile of railroad with a single track,* including buildings, fixtures and outfit.

Many of the railroads in progress will, perhaps, cost more than has been estimated for, but even if the actual cost should exceed the estimates by $15,000,000, the average cost per mile of railroad will not be more than $20,000.

Mr. D. Stevenson in his "*Sketch of Civil Engineering in North America*," (London, 1838,) gives a list of all the railroads completed and in progress in 1837. According to his statement, there were at that time 1652¼ miles of railroads in operation, and 2,760 miles in progress. The extent of railroads put into operation since 1837, or during the last three years, is therefore 1680 miles, being at an average of 560 miles per year; it must, however, be remarked that the extent of railroads put into operation in 1839 was less than might have been expected, owing to the difficulty of raising loans in Europe. If only half the length of lines which were graded had been completed, the number of miles in operation at the end of 1839 would have exceeded 4100, as was anticipated by the late Chevalier de Gerstner.

(To be continued.)

NINTH REPORT OF F. R. HASSLER, AS SUPERINTENDENT OF THE SURVEY OF THE COAST OF THE UNITED STATES, *and of the construction of Standards of Weights and Measures, rendering account of the works of* 1840.

1. The task of the coast survey for the present year, as well as that for the construction of standards of weights and measures, has been in part stated, and intimated in my last yearly report; it has been pursued with all attention and diligence, it was somewhat more complicated than in the preceding years, as may well be expected to be inherent in such kind of works in proportion as they progress.

2. Notwithstanding the calculations consequent to the primary and secondary triangulations, are always carried on immediately after the field work, and in proportion as the data are obtained, a full repetition of the series of calculations was required, and occupied several calculators all last winter, principally on account of the special task of executing the map of the harbor and neighborhood of New York, and by the bringing together upon the, so called, register maps, the full connections of the works, for future use; of these it was required to begin a second sheet for the part of the country south of Raritan bay, to the mouth of the Delaware, which will receive considerable filling up, by the works of last summer.

3. The projection, and reduction of the map of New York, was begun upon the scale of 1 to 30,000, in duplicate, by two assistants separately, both equally reducing from the original topographical maps, resulting from the plane-table works; these two original reductions will verify each other and prevent accidental errors, each of them will have its particular useful destination, which will appear in future.

4. The detail topography of the surveys in the field being grounded upon

* Compared with the total length of all the railroads, the length of those with a double track is inconsiderable.

the triangulation, it is proper that the reduction of the results of it be again grounded upon the same, whenever any part of the work shall be brought into execution, for the construction of a map. To obtain this aim I adopt the following new method; all the triangle points being placed in the projection, made for the map, by their latitude and longitude resulting from the accurate calculations, just mentioned, by their rectangular ordinates, referring to the nearest sides of the respective quadrilateres of the projection, the lines of triangles therefrom resulting upon the map, are used as abscisses, to which every detail point is referred by its rectangular ordinate, referred to the triangle sides.

5. This operation is very satisfactorily executed by rules and rectangular triangles, divided one set upon the scale of the original, the other set upon that of the map to be executed. By this means the union of the great number of detail maps, which in a large work concur in a reduced map, is obtained with the greatest accuracy, and the most ease, therefore also celerity.

I make this detailed statement, because the indication of this method may be of service to gentlemen, who may have similar works to execute.

6. The copper-plates for this map, which had been ordered in Vienna (Austria) have arrived in due time, by the kind assistance of the United States consul Schwartz at that place.

7. All the works here stated have of course required considerable of my personal attention and attendance, they are now in full, active, and regular, progress; adding to this the propriety of finally executing and comparing the number of standards of yards, upon which I have had the satisfaction to report to the treasury department the 10th of July last, there was sufficient good ground for me, to delay my going out in the field, to measure angles for the main triangulation, until later in the season; some of my assistants being engaged, during that time in reconnoitring preliminarily for appropriate station points for these triangles, at the same time that they pursued the secondary triangulation, a work which would have cost to me a considerable loss of time, in travelling about the country, which I considered far better employed in the manner I did.

8. This latter part of the season in which I am now engaged at the main triangulation, has hitherto been very favorable, and promises to continue so still onwards; this is so much more desirable as the nature of the country presents considerable difficulties by its configuration. If the weather of the coming season will allow it, I shall keep the field for the measurement of angles for the main triangles as long as ever possible, after which I intend still, under the favor of the woods being free of leaves, to reconnoitre myself for the discovery of more southern points for the main triangulation.

9. The elevations on either side of the valley of the Delaware, through which the main triangulation must necessarily pass, as has been already stated in my first plan of operation, are so little prominent, the one over the other, that it is difficult to find such as are elevated enough over the others, to afford a view to a sufficient distance, clear from intervening interruption. This occasions of course frequent cuttings of wood upon many hills, which are not always easily acceded to by the owners.

10. The denser atmosphere of the lower countries, and particularly the circumstance consequent thereto; that the rays of light between distant objects pass nearer to the surface of the earth, form a considerable impediment to the good vision required for the work; even the heliotropes, which render so essential services in the triangulation in general, by their light penetrating through a denser atmosphere than any signal, become by it inconveniently large, and diffused. The heliotropes had to be not only con-

siderably multiplied, on account of the number of stations requiring them but also I gave them a new form, easier transportable, and of little work in the construction, and the mirrors of the older ones were reduced, by diaphrams, to less than one-third of their size, to circles of about one inch diameter, this size proved far better appropriated to the shorter distance of the triangle points, and diminished very much the so inconvenient irradiation, which the larger square mirrors present in a denser atmosphere.

11. Two secondary triangulation parties were engaged this year, as habitual, the one following mainly the country west of the Delaware, and southerly to the head of the Chesapeake bay, over which triangles are laid out farther south than last year, the irregular conformation of the elevated parts of that country, and their generally more extended flat tops, lead naturally to equally irregular combinations of the triangles. These works therefore include all the State of Delaware, and parts of Pennsylvania, New Jersey and Maryland.

12. The monuments of the Mason and Dixon line, which are met in the course of this work, were found up, and triangles projected, by which they will be united to the general triangulation, which may afterwards be pursued further southerly and westerly, as well for the purely scientific purpose stated in my former report, as otherwise. It appears that some of the principal monuments at the north end of the line have been moved, and in general that not much attention has been paid to them since a long time; there is however still information enough obtainable for the approximate verification of the scientific result, which, I mentioned as the only use proper for the coast survey work, to make of these monuments, for they do not enter into consideration in that work in their quality of limits.

13. The other secondary triangulation party was engaged in the southern part of New Jersey, laying out a triangulation, from some lines of the other party near the Delaware, towards the Atlantic to the east, and towards the southern extremity to Cape May.

By these triangles the detail works of the Jersey shore, of which the topography had been survey last year, will be joined to the main triangulation, which, as above stated, must pass the shortest way through the valley of the Delaware; and the further continuation of the survey of the Jersey shore, as well for the topography, as for the hydrography, will be grounded upon them in the next operations of that kind, as well on the side of the Atlantic, as on the side of the Delaware.

The absence of all prominent elevations, and the wooded state of all except the lower valleys, renders these operations very tedious and timeconsuming.

14 As stated in my last report, there were yet some parts of the topography in Connecticut and Rhode Island: that had not been reached by the works of the previous years, on account of the close attention which was always given to the wants of the naval parties in the Long Island sound, whom it was necessary to supply constantly with the elments required for their works; the topography of these parts have been filled up this year, and also what remained of the parts of New Jersey to the southwest of Raritan bay, and a part on the Hudson river, yet needed to fill up the map of New York.

15. After the completion of these works, the topographical parties were turned, at different times, upon the parts of New Jersey between the formerly established shore lines of the bay of New York, or rather Raritan, on the north, and the last year's work on Barnegat bay, and that neighborhood, to the east, as far south as the strength of the parties allowed to extend their tasks.

16. In this part of the work will necessarily also be included a part of Pennsylvania in which it has been necessary by the configuration of the country to step over with the main triangulation, so much the more: as an important seaport Philadelphia and its approaches and communications, with the northern parts of the country, form a very essential part of the survey of the coast in that neighborhood.

17. Two naval parties were employed again this year, as formerly, but each of them had two vessels, instead of one as before, the two additional vessels were transferred to the coast survey from the revenue service, one to each party, they are both very well spoken of by the officers having command of the parties, as well appropriated to that service etc; the expenses occasioned by their purchase, their repairs and fitting up appropriately for the service in that work, occasioned of course additonal expenses, which had not been taken into consideration in forming the last year's estimate for the coast survey appropriation, thence contributed considerably to the diminution of the balance of funds now in hand for the coast survey work.

18. Both the naval parties had, like the topographical parties, still to fill up small portions of their work, at the eastern extremity of their former works, on both sides of Long Island sound. The one in Fisher's sound, and the other about Block Island, and the eastern extremity of Long Island These tasks were only of short duration, and of course executed the first.

19. The variations which all seacoasts, and particularly those of our country are subject to in the depth of their channels, made it proper to inquire if any change had occurred in the depth of the northern channel of the bay of New York, discovered by this coast survey; this channel was therefore sounded again in the whole of its separate course; the result was fully satisfactory, indicating rather a small deepening of the channel, than any diminution of depth, so that full reliance may be placed upon its permanency.

20. At the first beginning of the works of the coast survey, I had intended to carry on constant observations of the declination of the magnetic needle, and its variation, at the stations of the main triangulation, by which some data might be obtained, at different parts of the cost, upon this important element of this guide of the navigator, but the general press of the work not allowing to devote time for this purpose, the plan was abandoned after the first year; so much the rather as the main stations lay most generally more inland, than an adequate conclusion, upon the bearing of the needle on the approaches to the shore, could not fairly be drawn from them.

21. But I consider it proper, and advantageous; that at the entrance of the principal ports, such observations should be made once, for a certain time, as will give a proper fixed epoch, with corresponding determinations for this element; such as may be used and referred to in future; and which it will therefore be possible to bring to permanent usefulness, by the guidance of the results of the regular series of observations of the magnetic needle, by which its theory is now so extensively investigated. Such observations may so much the rather be expected to become useful, as a regular magnetic observatory is now established at the Girard College in Philadelphia, as it would be desirable to establish also at other places in this country, in systematic order.

22. With this view there has been made, during the greatest part of last summer, a regular series of observations of the declination of the magnetic needle, at a place near the entrance of the harbor of New York, with a

needle of one foot length arranged for inversion, and constructed for this purpose already in 1813.

The observations were made by observing the magnetic bearing of one of the lines of the triangles of the survey; this will furnish the magnetic azimuth of that line, while the terrestrial azimuth of it is given by the survey, the difference between them is the declination of the magnetic needle.

23. From out of the harbor of New York an excursion for soundings has been made till thirty miles from the shore, in search of accidental notable differences of soundings, which might occur; nothing deserving of special notice has as yet been found, but such investigations are of course to be continued in future.

24. The same naval party executed also, at the same time, with the smaller vessel belonging to it, the soundings of the bays along the outer shore of New Jersey, of Shrewsbury, Barnegat, Tuckertown, and Little Egg harbor about as far as the topography had been extended in that part last year, and elements had been given for the naval operations, to attach the soundings to the topography; the outer shore of that part of the sea-coast was of course investigated and sounded at the same time.

25. The other naval party, after having finished its work in Fisher's sound, was occupied in the river and bay of the Delaware; regular series of observations of the tide were made at different stations from Philadelphia to Cape Henlopen, the whole distance was besides reconnoitred with the view preparatory to the full survey, and accurate determinations of soundings, this will then be grounded upon the points of the two secondary triangulations which embrace more porticularly that river and bay, and those of the topographical survey, to be made of the two shores, simultaneously with these works, like this has been practised for the Long Island sound, and the other inland waters, hitherto surveyed.

26. This survey will require peculiar attention on account of the variability of the courses of the tides, which are different in ebb and in flood, besides their being much varied by the winds, and other circumstances, by which the channels are most likely constantly varied, either temporarily or permanently, so that no chart at present existing is trusted to present any accuracy, though, however, that may have been the case at the time of their construction.

27. When I was in Philadelphia in 1806, Mr. J. J. de Ferrer, a scientific gentleman as well known in this country as in Europe and South America, and I, were consulted upon the means of removing a bar then forming near Fort Mifflin, which was thought to endanger the navigation of the port by permanency; we were both equally of opinion that it would remove itself, by the nature and course of the working of the river, by being removed step by step down the river, until it should find a proper place to lodge its ground, and that so much the rather as a dam, then making at the Jersey shore of the river, with other views, appeared to me to have a tendency to promote this removal of the bar, from its then most unfavorable place; according to all informations this has been the case ever since, and the remains of this former deposite have almost disappeared in distributing themselves in the different opportune places which they met underways.

28. In the view of these circumstances it is evident, that there will be no just comparison possible to be established between the results of the present survey, and the older ones, made at different epochs, the ceritude which the results, to be obtained by the present survey shall give, will therefore be the most important result; establishing a determined state of the river, at a determined epoch of time; perhaps the comparison of it with the older

works may lead to, or at least furnish some data for, what might be called the history of the changes of the river, from which conclusions might be drawn advantageous for the future.

29. The special principles upon which the instruments used in the coast survey have been constructed, have continued always to be very advantageous and appropriate; the shop established in the office, necessary to maintain them constantly in good serviceable order, has furnished besides a number of instruments, and implements, of much superior accuracy, and adaptedness than would have been obtainable in any other way, besides that being always at hand, and every minute ready for such calls as cannot fail to occur constantly in such a work; the gain in time is an additional advantage of great economy, it is therefore of essential benefit, and continually in full activity.

Much of the parts forming in some measure materials for the works, have been procured, others ordered since more or less time, and not yet received, I have so much more hopes to receive them before the next yearly report, as I have had occasion to cause them to be pressed at their place of construction itself.

30. Several years ago propositions were made on the part of the State of Maryland, upon whose territory the coast survey has now entered, to partake in the survey of the coast, by certain arrangements with the Treasury Department, the principal character of which would be: that the triangulation of the coast survey should be made to extend, at the expense of the Government, farther inland, so as to serve as guide for the survey of the State, while the State would, in compensation of this, bear the expense of the whole of the topographical surveys, within its limits, to communicate them to the coast survey; the whole remaining under the same direction, and being carried on upon the same principles as the coast survey has been hitherto.

31. A similar proposition was made in 1817 by the State of New Jersey, when the coast survey was begun in that State, but the interruption of the coast survey at that time interrupted the negotiation. The double advantage that might result from such arrangements, with States partly covered by the coast survey, appears to me very evident, both in respect to the more economical manner in which by this mutual assistance the works would be made, as by the evidently greater perfection of both works, resulting from the greater extension of a regular system; it would equally tend to accelerate generally the final execution of both so desirable works.

32. If any proposition having a tendency to that effect, should be made by the State of Maryland, I wish to recommend it to the favorable consideration of the department; nearer particulars can be matured at the time, when the subject would be agitated, and the advantages to be obtained will then be nearer developed.

33. In relation to the amount of appropriation, which it is desirable to propose to Congress to grant for the coast survey expenses for the next year, I take the liberty to propose again the same amount of $100,000, which Congress has been so kind as to grant the two last years, it will appear by this report as well as by the general tenor of the work, and the state in which it is now, that its progress is just steadily going, adequate to that amount of expenditure, the appropriation being generally nearest expended fully by the time a new appropriation is made, and if any reduction would be required in the general establishment now existing for the work, it would prove a much greater disadvantage, and in fact actual loss, than the amount retained by a lesser appropriation would warrant, or make advisable to expose the work to particularly at the present momentaneous state of

it. I have also no doubt but Congress will willingly grant it, upon the confidence which I believe exists in Congress that the grants made for this work have always been applied with all possible economy, to the best advantage of the country, and that the work executed by their means are of great value for the general interest of the country, and adequate to the grant made for it.

Upon the construction of standards of weights and measures.

1. Since my last yearly report upon this part of my works, which is always, like now, added to that upon the coast survey works, I have had the honor to address to the Treasury Department a letter announcing the readiness for delivery of forty-one yards fully adjusted; having there also said a few words upon the other parts of the works relating to the construction of standards of weights and measures, I shall here take the liberty to refer to that letter for the most part of the account which might be given of these works since last year's report, and relate only what referred to the continuation since then.

2. The direction of the Treasury Department received in consequence of the above letter, having been: to send to certain named custom-houses eighteen of the yards thus finished, they were placed in proper packing-boxes, with paper wrapped around their inside mahogany fitting-boxes, and delivered to the collector of the customs at Alexandria, to forward according to their respective directions. The other twenty-three were equally packed, and prepared for delivery, the names of the States for whom they are intended are inscribed upon them; they are therefore ready to be forwarded, when called for, upon the invitation which the Treasury Department has directed to these States.

3. The quantity of standards of weights, and the yards for the States, just stated, fully ready and on hand in the office, all reported upon, made it desirable to make room for the other works now on hand, which required the full room again by their increase; with that view I took the liberty to propose, to deliver all this work, fully ready, and reported upon, into some of the vaults of the Treasury Department, for safe keeping; upon the answer of the Treasury Department acceding to this proposition, I delivered seventy-nine boxes of full sets of standard weights, packed ready for forwarding, which were deposited into a vault selected in the Treasury Department. Among these are yet several sets *belonging to States who have not yet called for them*, upon repeated invitations. At the same time there were deposited in this vault the twenty-three boxes of standard yards destined for States, the names of which they are inscribed with. The number of boxes deposited being thereby eighty-two, and the whole number of boxes delivered on that occasion, including the yards for the custom-houses, were one hundred and twenty. This gave room in the office to establish more order, and the free motion necessary to carry on the works still to be done.

4. The works which I stated in my letter of July as in hand, and yet to be executed, have gone on since, in the full proportion to the time elapsed, and will continue at the same rate henceforward.

5. In the winter it will be proper to take up again the revision of the liquid-capacity measures by weighing, up to their final adjustment, (but the boxes, which shall contain them when finished, are not yet made.) After these operations, which will still occupy some time, it will be possible to begin the adjustment of the half bushels, of which the mechanical work is finished, and which are placed in the boxes already made for them. These two operations of adjustment will be the most tedious of the whole

work, the great attention to be paid to the reduction for physical influences in the weighing, with the daily renewed distilled water, requires much attention, and the long-to-be-continued equal strain of attention in the sameness of weighing, are very fatiguing labor, to which no interest of variation or means of verifying the works, by varying the methods of operating, can be applied, like I did in the smaller weighings, by introducing a combinatory method, which excites some interest, at the same time that the independent mutual verification, which it affords, relieves the mind of the operator from the anxiety accompanying such operations, upon their success in accuracy; the masses to be weighed are too large to admit combination, which besides would become too complicated an operation. It can therefore also not be expected that they can progress with great celerity, or be pressed onwards in a hurried manner.

6. The plate-glass covers for all the capacity-measures, ordered at the plate-glass factory of St. Gaubin, have arrived in due time, and are fully satisfactory; by this the whole of this part of the establishment of standards, will present the most complete, and extensive systematic collection, that the present state of means, and knowledge admits, and as accurate as the wants of any transactions of the society requires.

F. R. Hassler.

Station Mount Holly, N. J., *Nov.* 17, 1840.

Pennsylvania legislature.—Mr. Johnson, chairman of the inland navigation and internal improvement committee, reported a bill to continue the improvements of the State, of which the following are items:

To pay debts due for repairs done before November 1, 1840.	$268,003
For repairs upon lines of Canals and Railroads, as follows:	
For Delaware Division.	$140,000
Philadelphia and Columbia Railroad.	40,000
Eastern division.	20,000
Juniata Division.	50,000
Allegheny Portage Railroad.	25,000
Western Division.	70,000
Beaver do.	10,000
Susquehanna do.	50,000
North Branch do.	50,000
West Branch do.	25,000
French Creek Feeder.	40,000
Debts due on Sinnemahoning Extension.	1,206
Towards the construction of Reservoirs at the east and west terminations of the Portage Railroad.	150,000
For damages, pay of Canal Commissioners, Appraisers, Engineers, &c.	30,000
For new work on finished lines.	30,000
For motive power on Portage Railroad.	25,000
To the Shenango and Conneaut line of Erie Extension.	600,000
To the Tioga and Tunkhannock line of North Branch Extension,	600,000
To the Sinnemahoning Extension of the West Branch Canal,	100,000
For Allegheny Feeder,	100,000
To Wisconisco Canal,	100,000
For second track and to avoid Inclined Plane at Columbia,	75,000
To complete Dam at Farrandsville,	25,000

The Governor is authorized and required to subscribe for 750 shares of the Union Canal Stock, and give negotiable certificates of loan to the amount of $150,000 in payment thereof.

Also, for 1000 shares of the Bald Eagle and Spring Creek Navigation Company.

The Governor is also authorized, in case of extraordinary freshets, to borrow money on the faith of the Commonwealth.

Mr. Dunlap, from the same committee, reported a bill authorizing the New York and Erie railroad company to extend their road through a part of Susquehanna county in this State.

The Works of Antiquity compared with the Ohio Canal.—Nothing is more common than to hear people speak of the immense works of antiquity, and assert that there is nothing of the present day that will compar with them, and it is customary to hear them say that it must have taken *centuries* to have completed even a single work. Now let us compare the works of the ancients with that of the moderns. Take for instance the great pyramind of Cheops in Egypt. It is estimated to contain six millions of tons of Granite and that it would take all the ships, steamboats and vessels in the world to carry it at one cargo. Now this is all very true, but it was built by a country numbering thirteen millions inhabitants. The Ohio Canal is 209 miles long, of an average width of 40 feet, and must have involved the excavation of upwards of 8 millions tons of earth, besides the stone necessary to build about 140 locks, containing 5 millions cubic feet of cut stone, to say nothing of timber necessary for lock-gates, dams, etc. The Ohio canal was built by a free State, containing a population of less than one million, in the short space of six years and a half! Nowhow long would it have taken the people of Ohio, numbering fifteen hundred thousand, to have built the pyramid of Cheops? Answer, about *two years and ten days.*

Railway Talking Machine.—A late English journal in referring to the London and Blackwall railroad, mentions a "talking machine" constructed with galvanic wires, by means of which conversation could be carried on between London and Blackwall with the greatest ease and precision. By way of illustrating the efficiency of this talking machine Mr. Stephenson said that he went to the station in London one day to inquire for one of his assistants. He was not there, but the attendant said that he would inquire if he was at the other end of the line; he did so; in a few seconds the answer was that he was not there. But about five minutes afterward the talking machine informed him in London that his assistant had arrived at the Blackwall terminus; upon which he instructed the attendant to say by the same agency, "tell him to come here directly." In ten minutes from that time he arrived, the distance being nearly seven miles. If the distance were 100 miles the conversation could be carried on just as readily, for the communication travelled at the rate of 20 miles a second.—*N. Y. Times.*

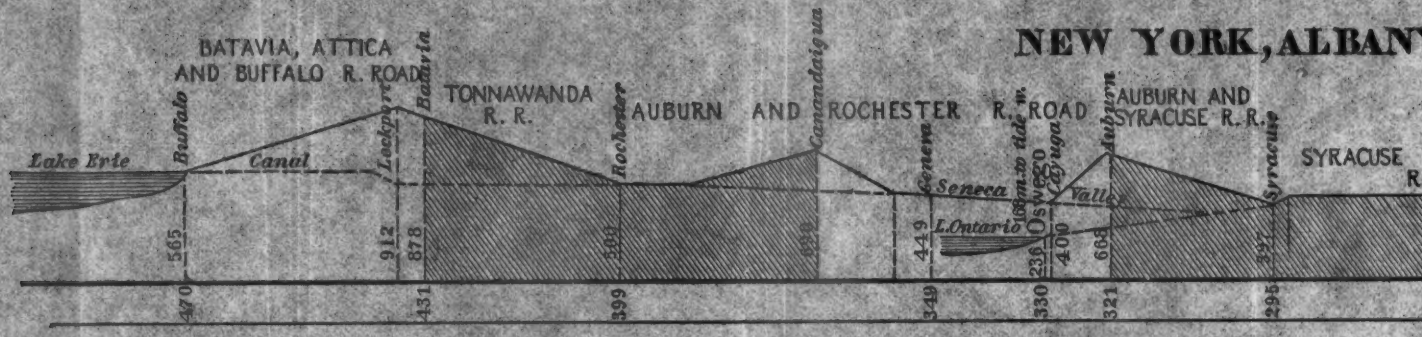
Steam Navigation between Bremen and New York.—We are extremely glad to inform our readers (says the Philadelphia *Standard*) that the regular steam navigation between the Hanseatic town of Bremen and New York, will probably commence in the spring. The steamer which is to be built in Bremen, for that purpose, will be of 1000 tons. The shares were subscribed for in two days. But one shareholder belongs to an old family of the city, all the rest, the German papers say, are men originally from the country, who made their own fortunes.

The ship Isaac Newton, now loading at this port for Hamburg, has on board two of *Norris'* Locomotive Engines, worth some twenty-five thousand dollars, destined for a railroad in Prussia.—*New York American.*

PROFILES OF THE THREE GREAT RAIL-ROAD ROUTE

Horizontal scale 30 miles to 1 inch.—Vertical scale 1,000 fe

NEW YORK, ALBAN



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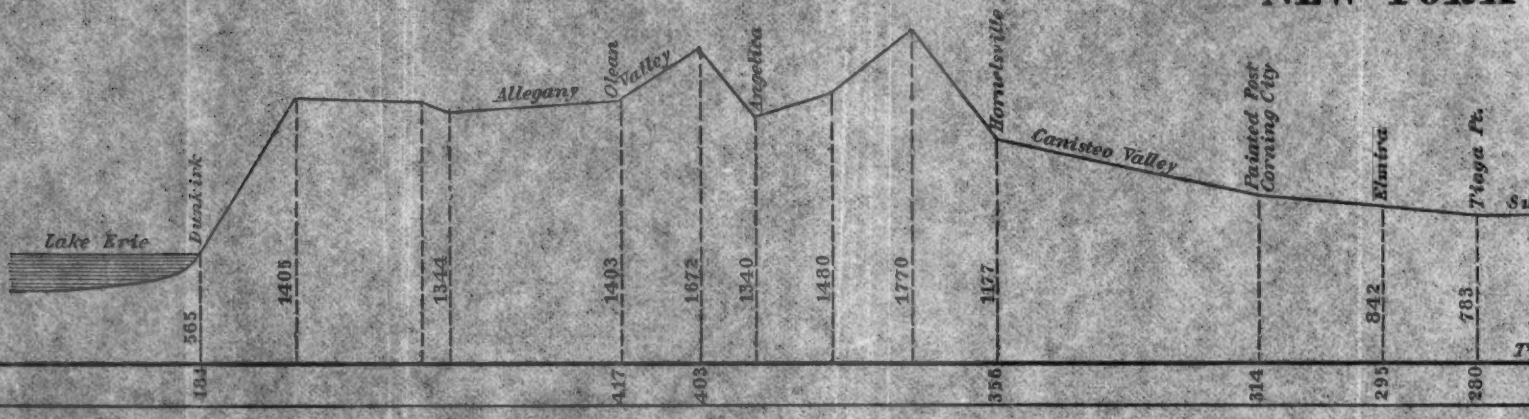

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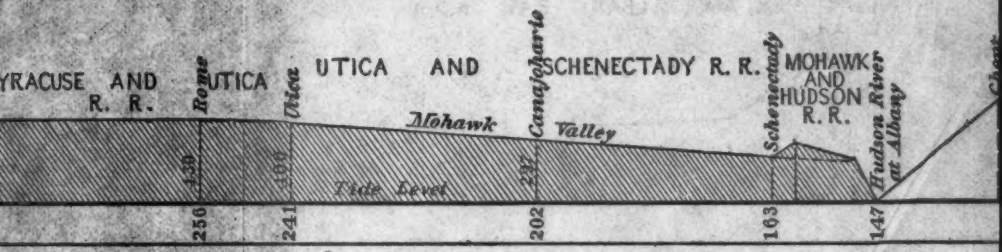
L.F. JOHNSON CIV. ENG. DELT.

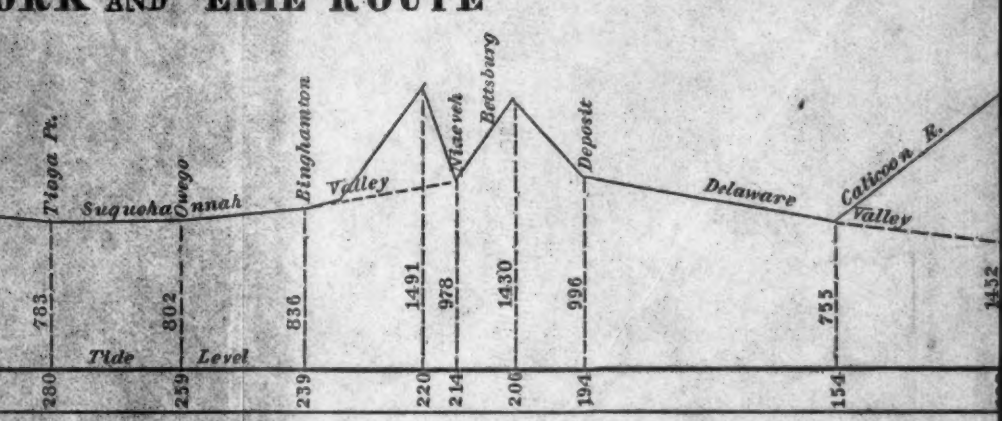
UTES EXTENDING FROM NEW-YORK C

e 1,000 feet to 1 inch.—The Portions shaded, are complete and in operation.

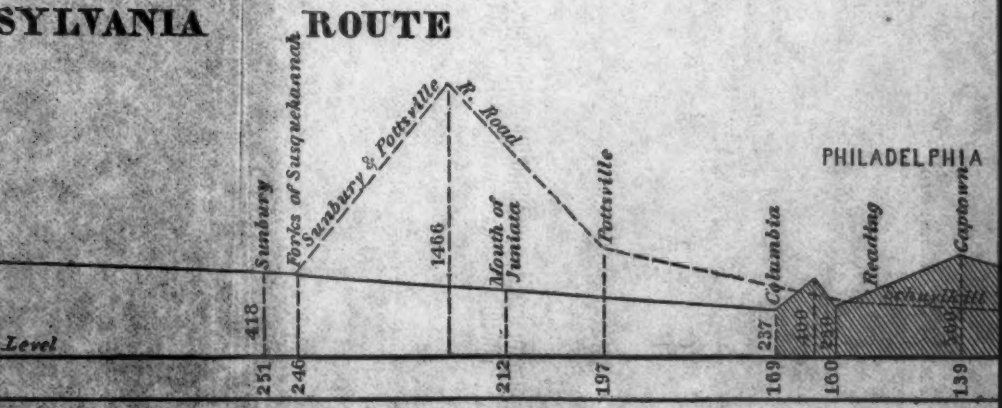
LBANY AND BUFFALO ROUTE



ORK AND ERIE ROUTE



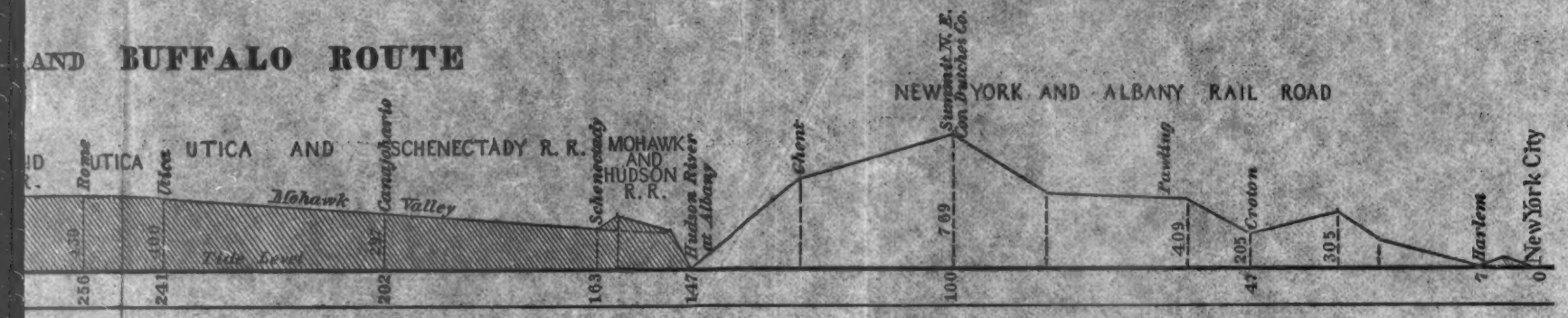
SYLVANIA ROUTE



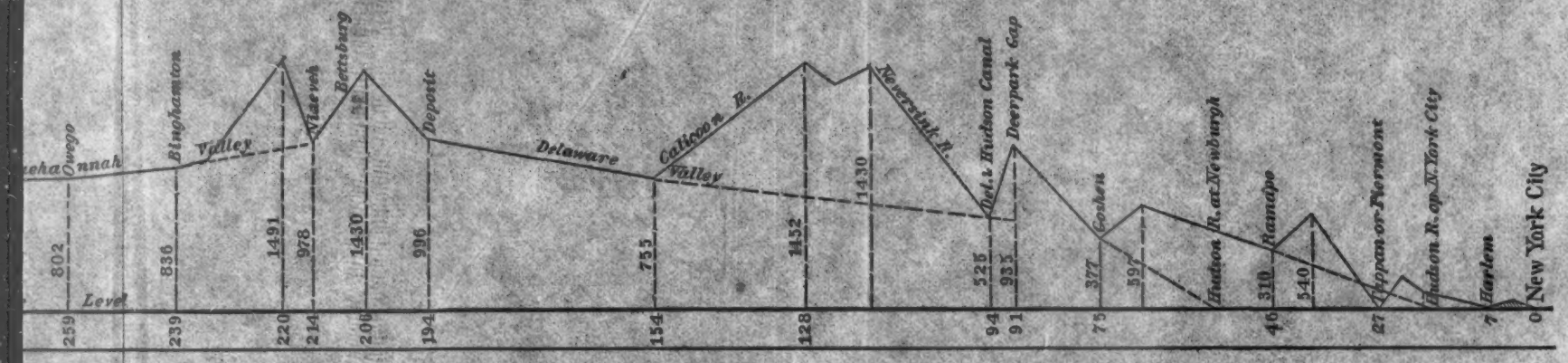
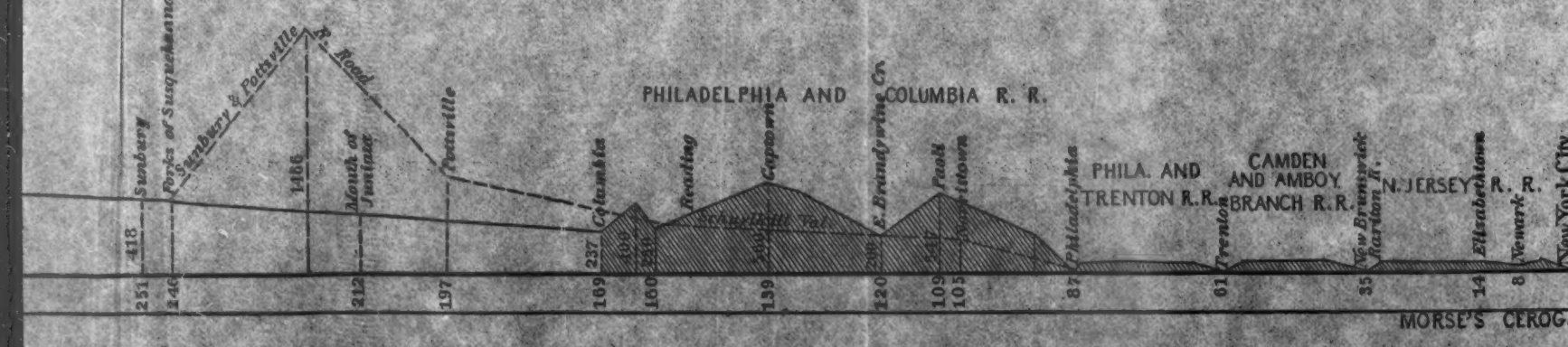
EXTENDING FROM NEW-YORK CITY TO LAKE ERIE.

o 1 inch.—The Portions shaded, are complete and in operation.

AND BUFFALO ROUTE



ND ERIE ROUTE



NIA ROUTE